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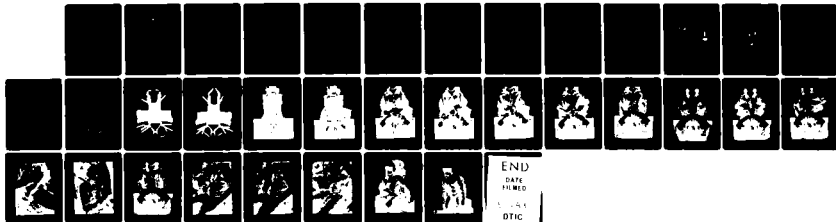
EJECTION SEAT-MOUNTED CREWMEMBER RESTRAINT INTEGRATED  
WITH SURVIVAL VEST A..(U) NAVAL AIR DEVELOPMENT CENTER  
WARMINSTER PA AIRCRAFT AND CREW S.. T J ZENOBI

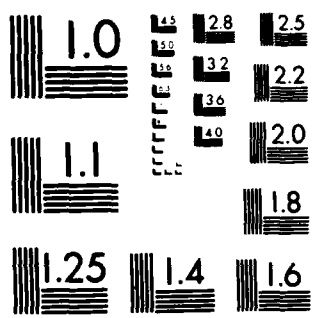
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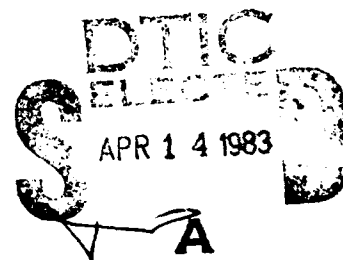
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# EJECTION SEAT-MOUNTED CREWMEMBER RESTRAINT INTEGRATED WITH SURVIVAL VEST AND FLOTATION

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Warminster, PA 18974

15 NOVEMBER 1982

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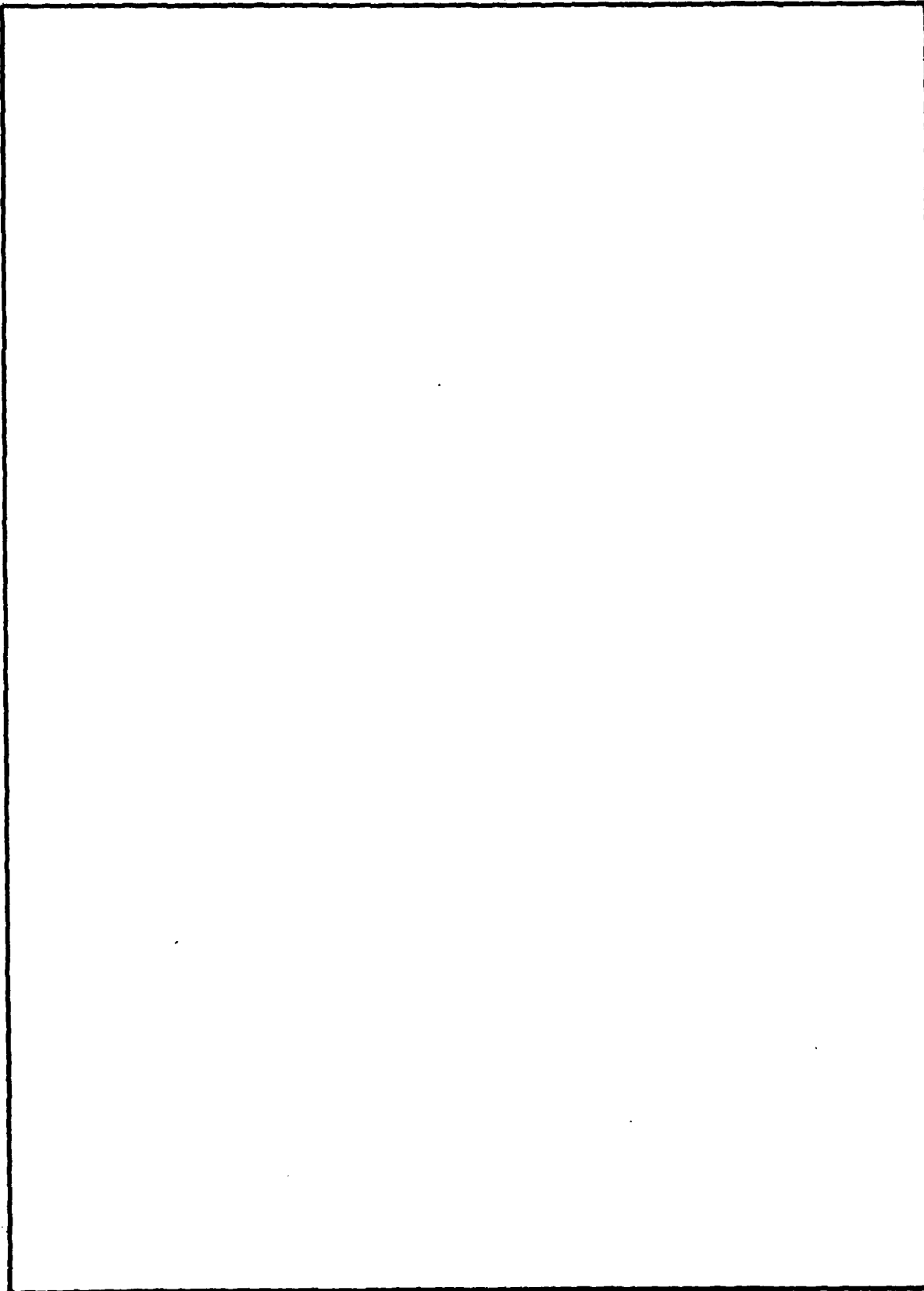
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Project Description	
Project Objectives	
Project Deliverables	
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## INTRODUCTION

The Seating and Escape Branch (Code 6032) of the Aircraft and Crew Systems Technology Directorate is developing a flight restraint/parachute harness integrated with attached survival vest (SV-2B) and life preserver (LPU-23/P). The entire assembly is mounted on the ejection seat in military aircraft. This integrated restraint concept is an alternative approach to the current procedure in which the crewmember must don the three separate garments – the MA-2 torso harness, the SV-2B survival vest, and the LPU-23/P life preserver (See Figures 1 through 4.) – before getting into the aircraft cockpit. (Under Aircrew System Change No. 380, some squadrons have modified the MA-2 torso harness for storage of survival items. With this modification the SV-2B is not required.)

The seat-mounted integrated harness is expected to offer about the same quality of in-flight restraint as the MA-2 torso harness.

The expected benefit is that it will help Integrated Logistic Supportability (ILS) of equipment by reducing the number of harnesses, life preservers and survival vests in the Navy inventory. The inventory would reduce from one or more sets of items per crewmember to one set per ejection seat.

If the torso restraint/parachute harness portion alone were seat mounted or if it were mounted with either the SV-2B or LPU-23/P, there would still be an improvement in the logistic support.

## DESIGN CRITERIA

The seat-mounted integrated harness assembly is designed to the following requirements:

- The harness assembly must retrofit on current ejection seats without redesign of attachment points on the seat.
- The harness assembly must withstand 30 G parachute opening shock tests using a ninety-eight percentile dummy and must properly distribute parachute loads.
- The harness assembly must have no more than two quick release points for doffing.
- The harness must fit crewmember anthropometric sizes from third percentile to the ninety-eighth percentile.
- The harness assembly must be fabricated of "off-the-shelf" items. This includes the survival vest, life preserver, and torso restraint and parachute harness.

For immediate retrofit purposes the prototype design does not include a negative G or tie-down strap. If a given aircraft is designated to require such a strap, then it will be adapted to the harness assembly. This should not be difficult since there are single point attachment fittings with an attached tie-down strap now being offered to the military by various manufacturers.

## PROTOTYPE DESIGN

The seat-mounted integrated harness prototype was designed and constructed at NADC. It consisted of a European Alpha Jet seat-mounted restraint/parachute harness as the basis of the assembly design. It was arbitrarily selected to determine the feasibility of attaching a survival vest

and flotation to a seat-mounted harness. The configuration of the Alpha Jet harness is shown in Figure 5. The standard SV-2B and LPU-23/P were then altered and attached to the harness. The resulting integrated harness is shown in Figures 6 and 7 and mounted on a seat in Figures 8 and 9.

The LPU-23/P and SV-2B alterations consisted mainly of cutting away existing straps and buckles. Although portions of the prototype were sewn to fasten material together, snap fasteners would be recommended for updated designs.

The integrated harness has two quick-release buckles. One buckle which is made for seat mounted torso/parachute harnesses is used for doffing and donning the harness and part of the SV-2B and LPU-23/P. A second smaller quick-release buckle is used for doffing and donning the SV-2B portion of the assembly.

All alterations and assembly of the items used in the prototype design were performed in less than eight man-hours. This short assembly time for the prototype can be attributed to the use of "off-the-shelf" items and material.

The procedure for putting on and taking off the seat-mounted integrated harness assembly are shown in the sequence of figures from Figure 10 through Figure 25.

- Figure 10 — Crewmember fastens lap belt into single point attachment buckle
- Figure 11 — Crotch strap routed through shackle on lap belt
- Figure 12 — Shoulder strap routed through loop in crotch strap
- Figure 13 — Loop fastener on SV-2B and LPU-23/P assembly looped over shoulder strap buckle insert
- Figure 14 — Should strap insert connected to single point attachment buckle to secure left half of harness and part of SV-2B and LPU-23/P assembly
- Figure 15 — Procedures repeated to secure right half of harness
- Figure 16 — Second buckle connected to complete donning of SV-2B and LPU-23/P assembly
- Figure 17 — Strap adjustment for SV-2B
- Figure 18 — Lap belt adjustment
- Figure 19 — Shoulder strap adjustment
- Figure 20 — Crewmember ready for flight
- Figures 21 & 22 — Crewmember actuates quick release fitting to partially doff SV-2B and LPU-23/P assembly
- Figures 23 & 24 — Crewmember twists and punches single point attachment buckle to release torso/parachute harness and remainder of SV-2B and LPU-23/P assembly
- Figure 25 — Crewmember is free of seat (Leg restraint lines, if used, will require separate action by crewmember)

## MAINTAINABILITY

The effects of heat and sunlight on the integrated harness assembly while the aircraft is parked outdoors appears to be the major maintainability concern. Perhaps, these environmental factors will cause faster deterioration of the life preserver and some items in the SV-2B than currently experienced. This would lead to more frequent maintenance checks and, possibly, replacement. However, through the use of snap fasteners the removal and replacement of the LPU-23/P can be done quickly and easily. Items in the SV-2B are also readily accessible and easily replaced.

If frequency of replacement is unacceptable, then the design would have to include protection for the equipment against the environmental affects.

#### FUTURE EFFORTS

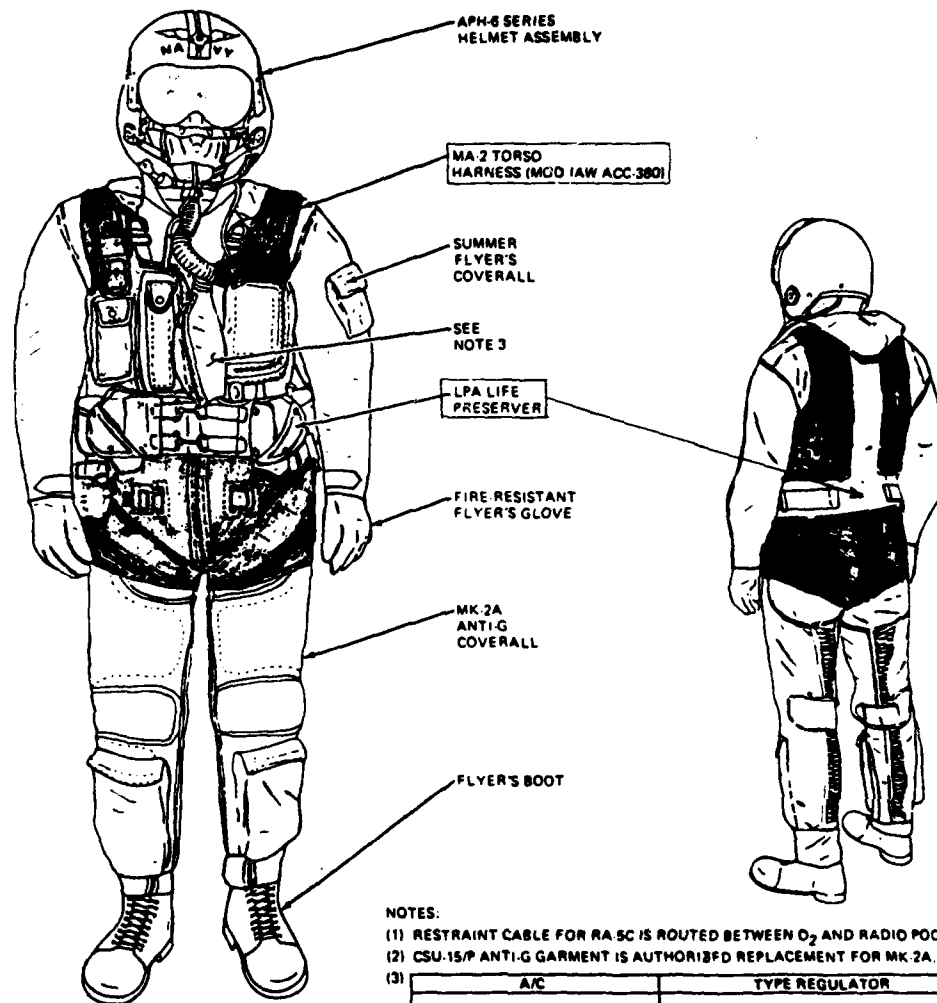
The integrated harness must still undergo performance tests including its use as a parachute harness and as an in-water life preserver. A lift ring will be added and tested to ensure proper life capability for rescue operations.

The most important evaluations will have to be made by crewmembers when the prototype designs undergo human factors evaluations in the near future. These evaluations will consider ease of donning and doffing, adjustability, comfort, and maneuverability.

Aside from obtaining proper performance and crewmember acceptance, the development effort will strive to keep the integrated harness fabrication and maintenance simple and inexpensive.

#### ACKNOWLEDGEMENT

The author wishes to extend his appreciation to Mr. R. Pursell for his assistance in the fabrication of the integrated harness prototype.



NOTES:

- (1) RESTRAINT CABLE FOR RA-5C IS ROUTED BETWEEN O<sub>2</sub> AND RADIO POCKETS.
- (2) CSU-15/P ANTI-G GARMENT IS AUTHORIZED REPLACEMENT FOR MK-2A.

(3)

A/C	TYPE REGULATOR
A-3	AIRCRAFT PANEL MOUNTED REGULATOR
A-4, A-7, RA-5C, F-4, F-8, F-14, T-2	MINIATURE REGULATOR

A-3 Series, A-4 Series, T-2 Series, RA-5C, A-7 Series, F-4 Series, VTAS II), F-8 Series, F-14 Series

Figure 1. Typical Flight Clothing



Figure 2. SV-2B Survival Vest

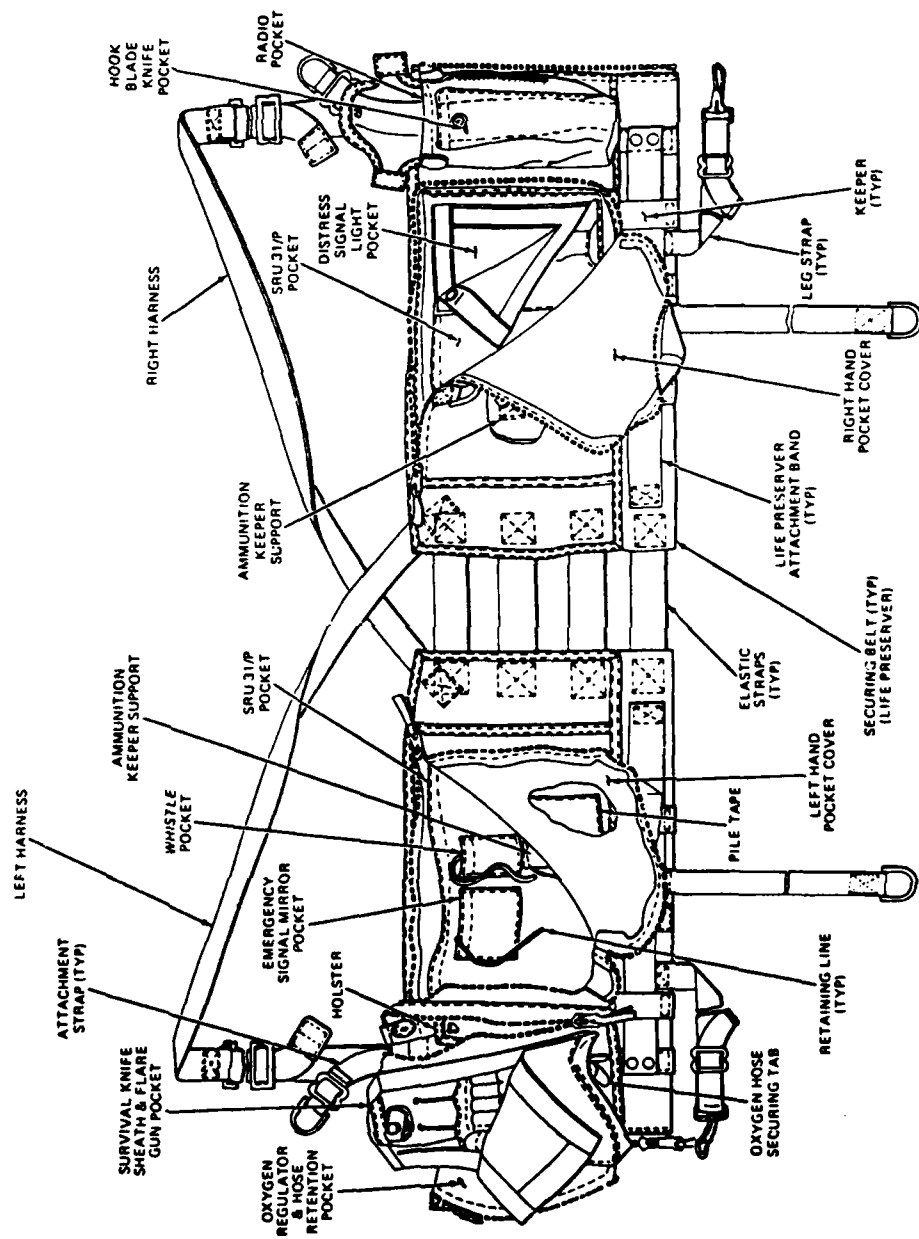


Figure 3. SV-2B, Parts Nomenclature

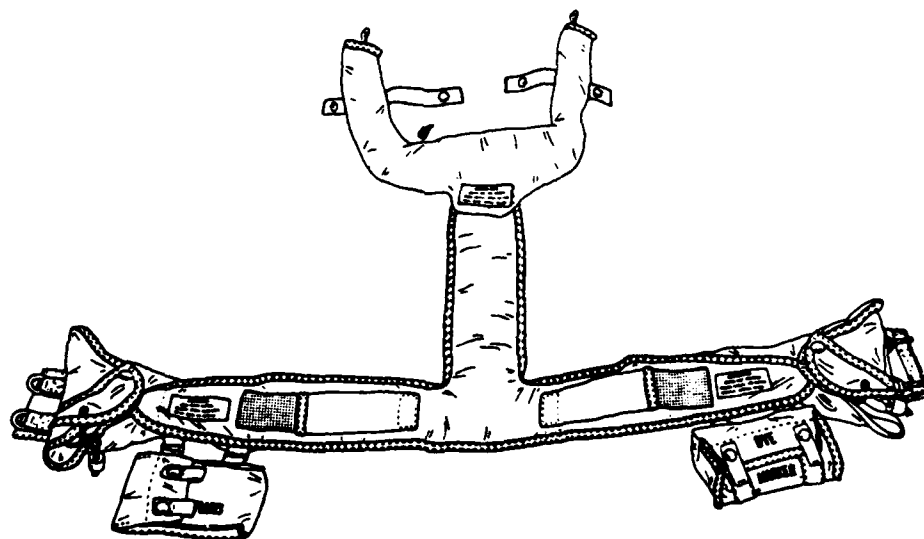
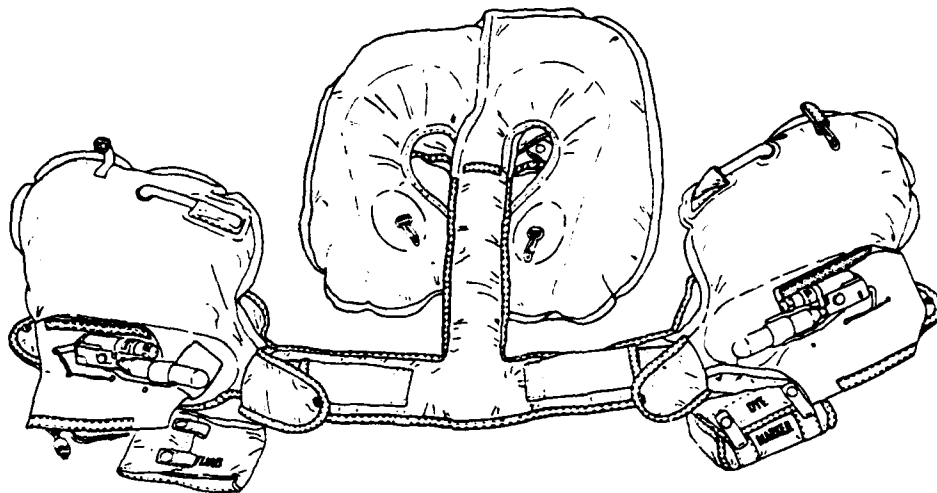


Figure 4. LPU-23/P Life Preserver Assembly

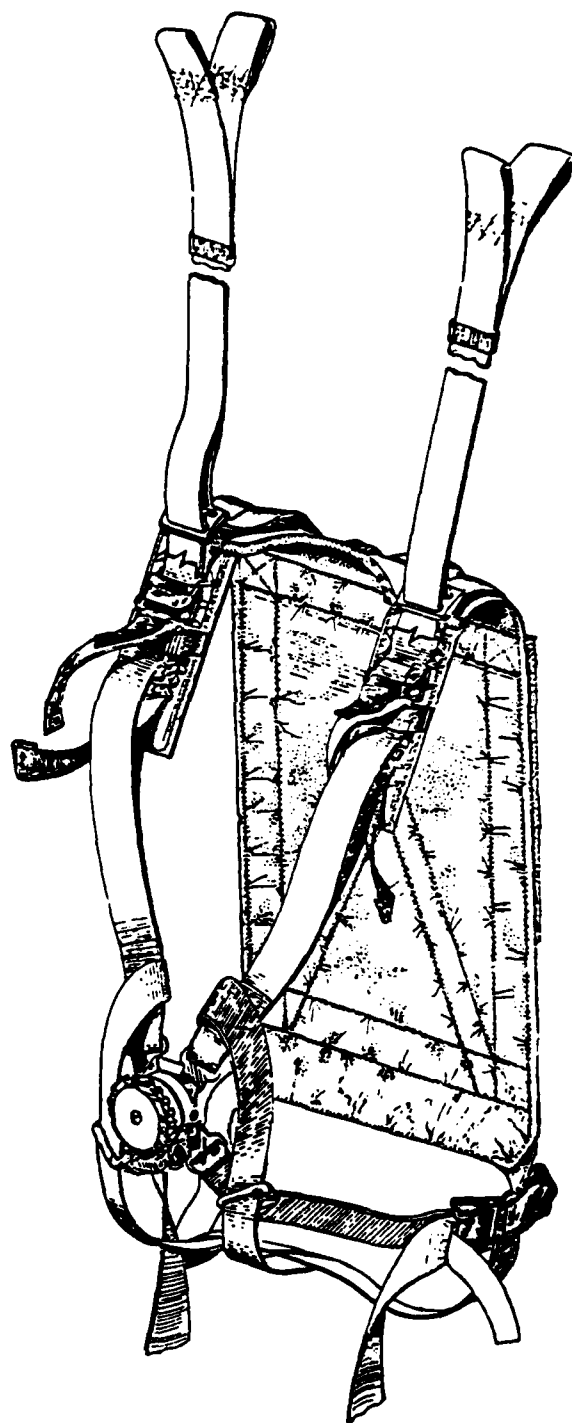


Figure 5. Basic Seat Mounted Torso Restraint and Parachute Harness



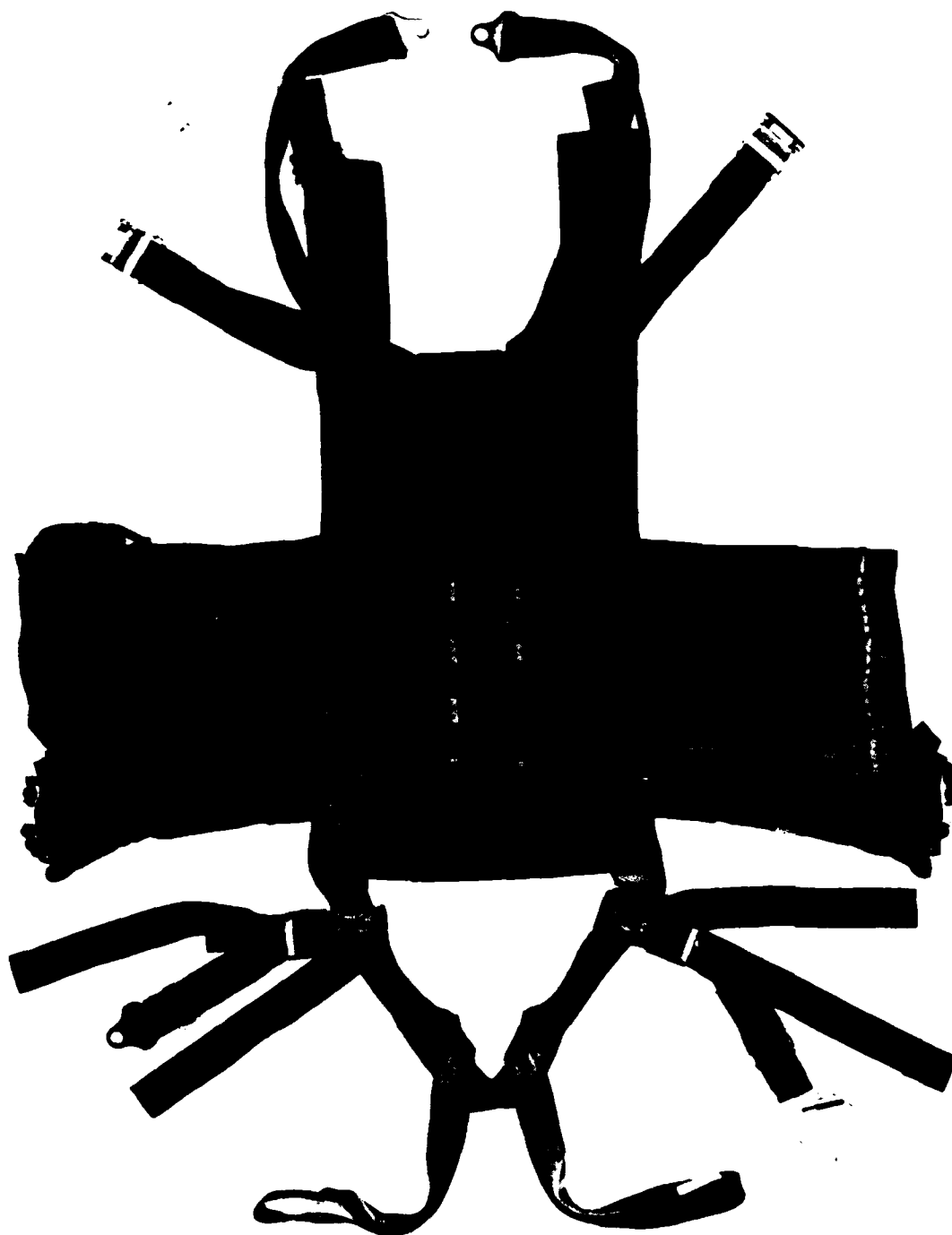


Figure 6. Integrated Harness Assembly — Inside View

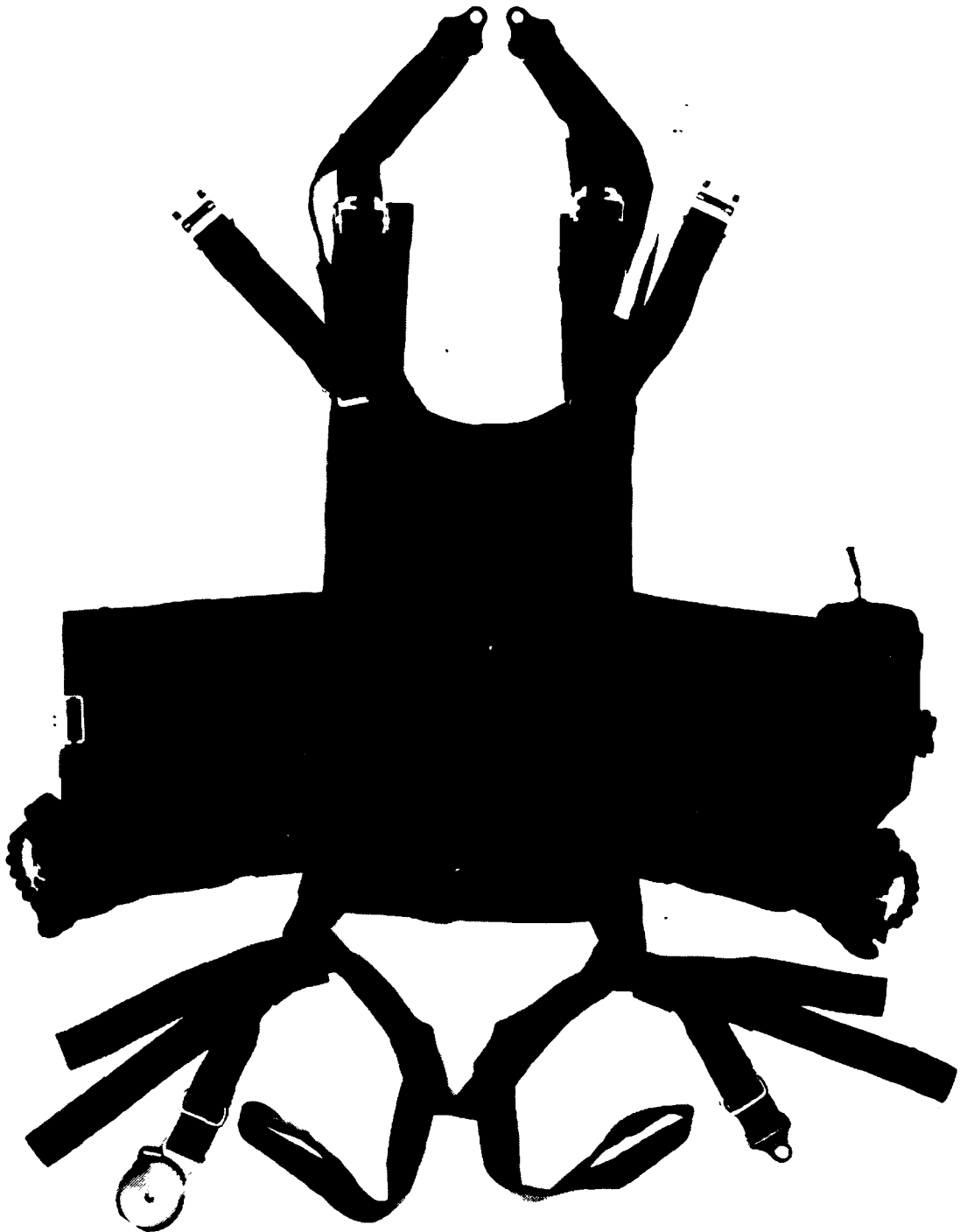


Figure 7. Integrated Harness Assembly – Outside View

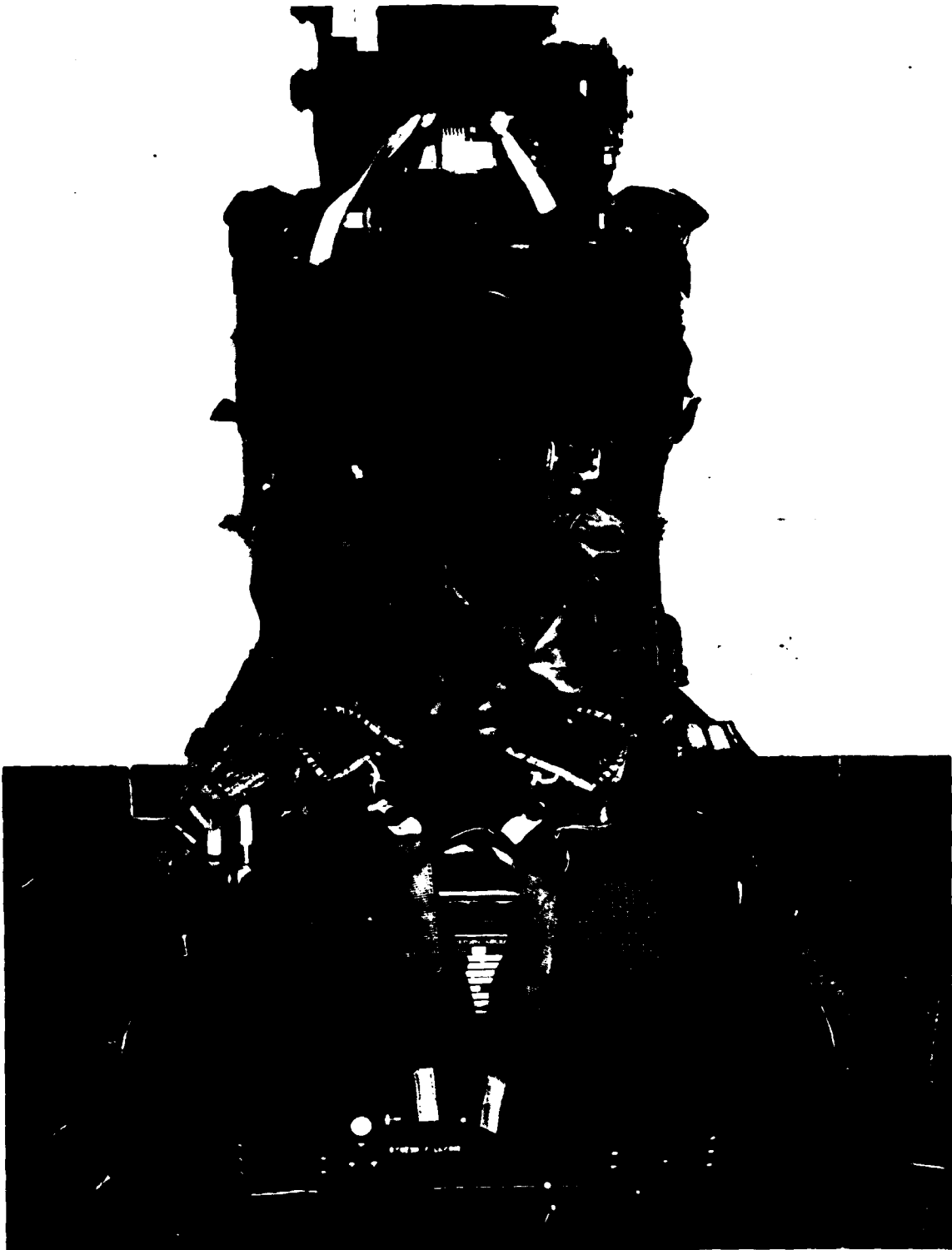


Figure 8. Integrated Harness Assembly Mounted on Ejection Seat (View 1)

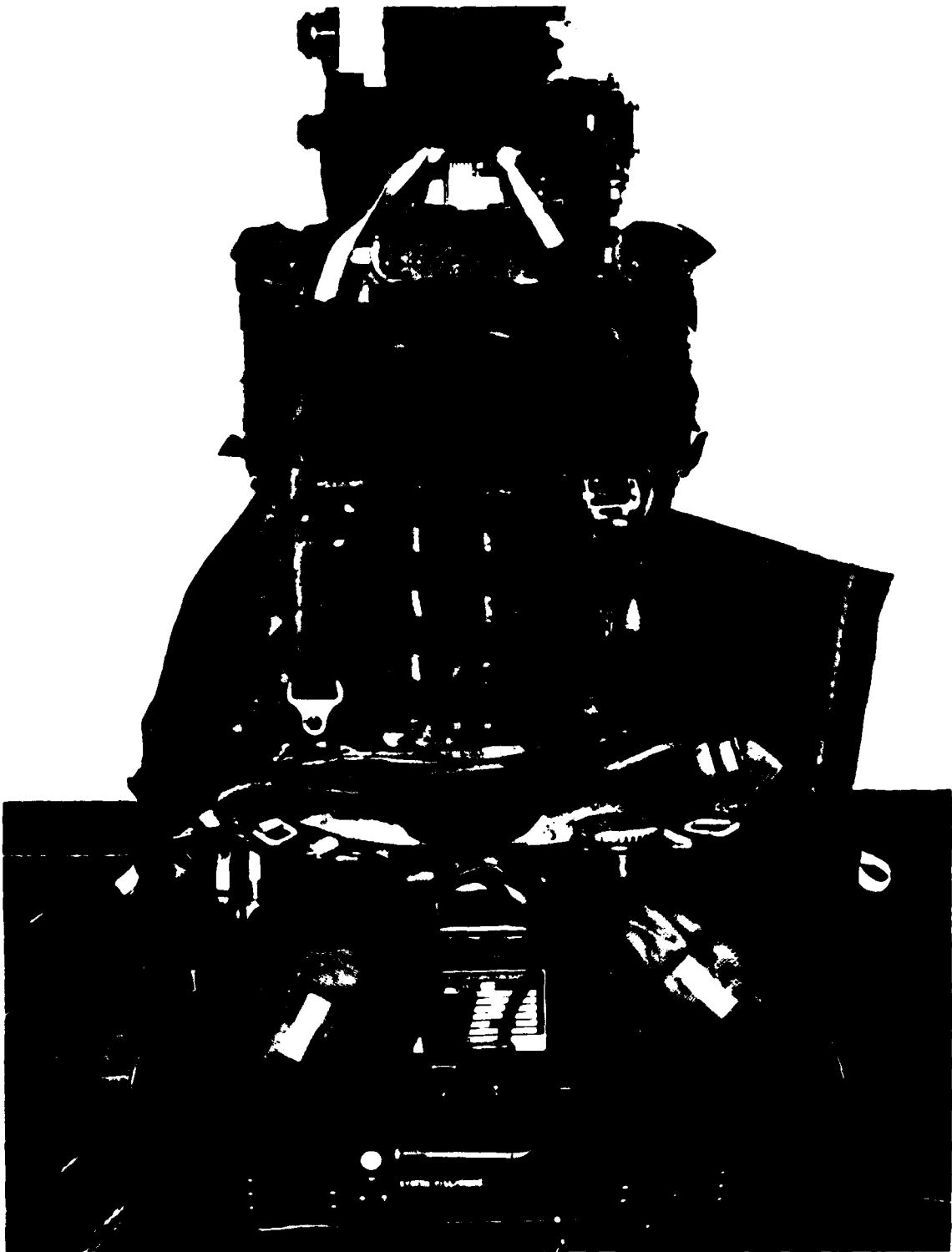


Figure 9. Integrated Harness Assembly Mounted on Ejection Seat (View 2)

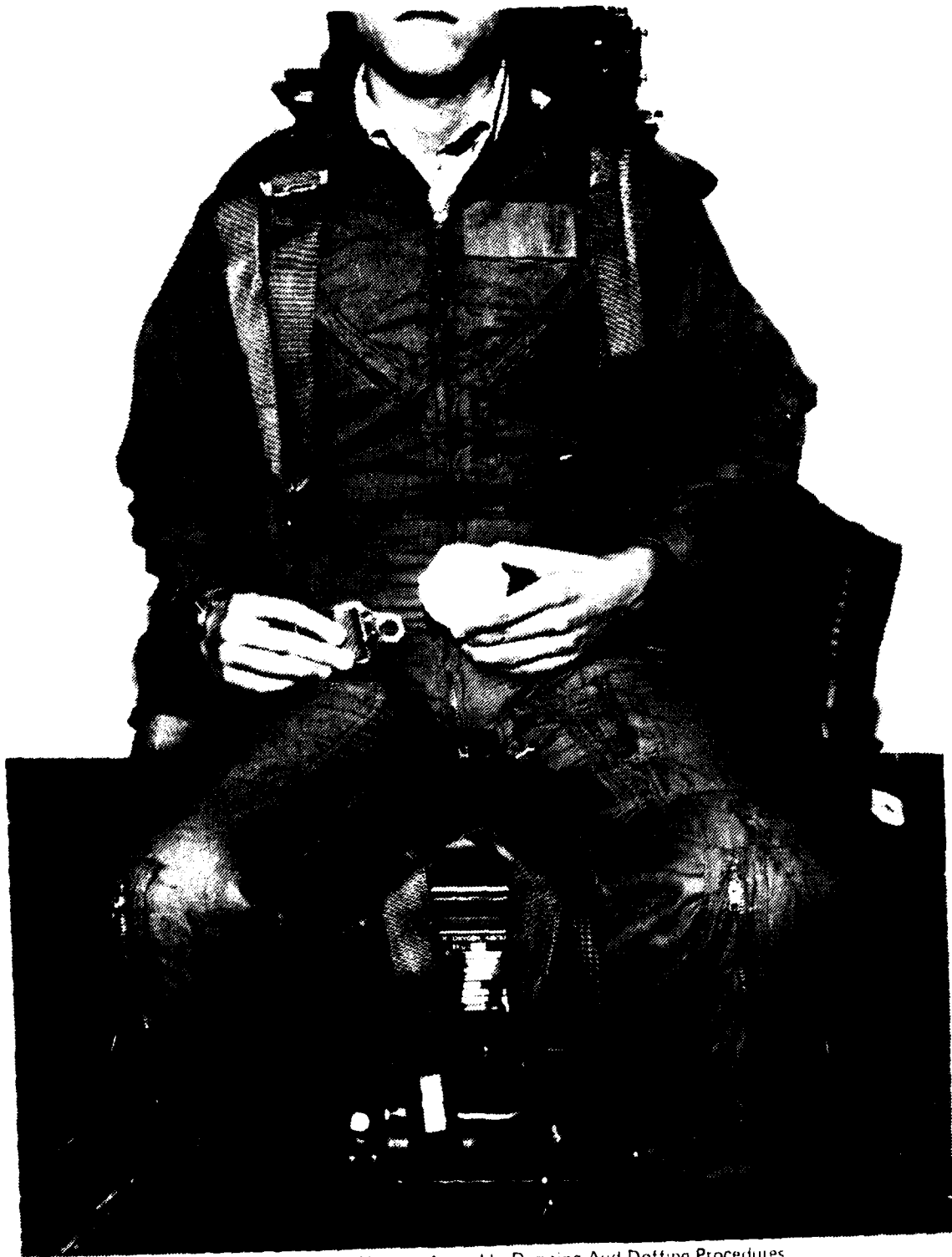


Figure 10. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember fastens lap belt into single point attachment buckle.)



Figure 11. Integrated Harness Assembly Donning And Doffing Procedures  
(Crotch strap routed through shackle on lap belt.)



Figure 12. Integrated Harness Assembly Donning And Doffing Procedures  
(Shoulder strap routed through loop in crotch strap.)



Figure 13. Integrated Harness Assembly Donning And Doffing Procedures  
(Loop Fastener on SV 2B and LPU 23/A assembly looped over shoulder strap buckle insert.)





Figure 14. Integrated Harness Assembly Donning And Doffing Procedures  
(Shoulder Strap insert connected to single point attachment buckle to secure left half of harness and part of SV 2B and LPU 23/A assembly.)

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Figure 15. Integrated Harness Assembly Donning And Doffing Procedures  
(Procedures repeated to secure right half of harness.)

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Figure 16. Integrated Harness Assembly Donning And Doffing Procedures  
(Second buckle connected to complete donning of SV 2B and LPU 23 A assembly.)



Figure 17. Integrated Harness Assembly Donning And Doffing Procedures  
(Strap adjustment for SV 2B.)



Figure 18. Integrated Harness Assembly Donning And Doffing Procedures  
(Lap belt adjustment.)



Figure 19. Integrated Harness Assembly Donning And Doffing Procedures  
(Shoulder strap adjustment.)



Figure 20. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember ready for flight.)



Figure 21. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember activates quick release fitting to partially doff SV-2B and LPU-23/A assembly.)





Figure 22. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember activates quick release fitting to partially doff SV-2B and LPU 23'A assembly.)



Figure 23 Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember twists and punches single point attachment buckle to release torso parachute harness  
and remainder of SV 2B and LPU 23 A assembly.)



Figure 24. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember twists and punches single point attachment buckle to release torso parachute harness  
and remainder of SV-2B and LPU 23/A assembly.)



Figure 25. Integrated Harness Assembly Donning And Doffing Procedures  
(Crewmember is free of seat. Leg restraint lines, if used, will require separate action by crewmember.)

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